Bond Prices and Yields

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Bodie, Kane, and Marcus
Essentials of Investments,
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10.1 Bond Characteristics

- Bond
  - Security that obligates issuer to make payments to holder over time
- Face Value, Par Value
  - Payment to bondholder at maturity of bond
- Coupon Rate
  - Bond's annual interest payment per dollar of par value
- Zero-Coupon Bond
  - Pays no coupons, sells at discount, provides only payment of par value at maturity

Figure 10.1 Prices/Yields of U.S. Treasury Bonds

U.S. Treasury Quotes: Treasury note and bond data are representative over-the-counter quotations as of 3pm Eastern time.

Maturity	Coupon	Bid	Asked	Change	Asked Yield
8/15/2012	1.750	101.570	101.594	-0.016	0.151
8/15/2014	4.250	111.547	111.594	-0.094	0.358
12/31/2015	2.125	105.789	105.820	-0.164	0.769
8/15/2017	4.750	120.219	120.266	-0.234	1.234
2/15/2020	8.500	152.063	152.094	-0.344	1.847
8/15/2023	6.250	137.406	137.438	-0.688	2.598
2/15/2027	6.625	145.547	145.594	-0.719	2.941
2/15/2031	5.375	130.266	130.297	-0.953	3.263
11/15/2039	4.375	111.766	111.813	-0.813	3.697
5/15/2041	4.375	111.719	111.750	-0.938	3.718

10.1 Bond Characteristics

- Treasury Bonds and Notes
  - Accrued interest and quoted bond prices
    - Quoted prices do not include interest accruing between payment dates
  - Accrued interest $= \frac{\textit{Annual coupon payment}}{2} \times \frac{\textit{Days since last coupon payment}}{\textit{Days separating coupon payments}}$

Figure 10.2 Listing of Corporate Bonds

ISSUER NAME	SYMBOL	COUPON	MATURITY	RATING MOODY'S/S&P/ FITCH	HIGH	LOW	LAST	CHANGE	YIELD %
JPMORGAN CHASE & CO	JPM.LHD	3.125%	Dec 2011	Aaa/AA+/AAA	100.907	100.786	100.829	0.079	0.305
GOLDMAN SACHS GP	GS.AOK	5.250%	Jul 2021	–/A/–	103.899	99.790	100.490	–0.225	5.186
CITIGROUP	C.AGT	5.375%	Aug 2020	A3/A/A+	109.280	105.900	107.994	0.818	4.293
BP CAPITAL MARKETS PLC (DUPLICATE)	BP.JW	3.200%	Mar 2016	A2/A/A	106.350	105.783	105.827	–0.451	1.864
BANK OF AMERICA CORP	BAC.XQ	4.875%	Sep 2012	A2/A/A+	102.917	99.000	101.625	–0.930	3.333
AT&T	T.MA	4.450%	May 2021	A2/A–/A	111.614	108.500	110.129	1.720	3.230

10.1 Bond Characteristics

- Corporate Bonds
  - Call provisions on corporate bonds
    - Callable bonds: May be repurchased by issuer at specified call price during call period
  - Convertible bonds
    - Allow bondholder to exchange bond for specified number of common stock shares

10.1 Bond Characteristics

- Corporate Bonds
  - Puttable bonds
    - Holder may choose to exchange for par value or to extend for given number of years
  - Floating-rate bonds
    - Coupon rates periodically reset according to specified market date

10.1 Bond Characteristics

- Preferred Stock
  - Commonly pays fixed dividend
    - Floating-rate preferred stock becoming more popular
  - Dividends not normally tax-deductible
    - Corporations that purchase other corporations' preferred stock are taxed on only 30% of dividends received

10.1 Bond Characteristics

- Other Domestic Issuers
  - State, local governments (municipal bonds)
  - Federal Home Loan Bank Board
  - Farm Credit agencies
  - Ginnie Mae, Fannie Mae, Freddie Mac

10.1 Bond Characteristics

- International Bonds
  - Foreign bonds
    - Issued by borrower in different country than where bond sold, denominated in currency of market country
  - Eurobonds
    - Denominated in currency (usually that of issuing country) different than that of market

10.1 Bond Characteristics

- Innovation in the Bond Market
  - Inverse floaters
    - Coupon rate falls when interest rates rise
  - Asset-backed bonds
    - Income from specified assets used to service debt
  - Pay-in-kind bonds
    - Issuers can pay interest in cash or additional bonds
  - Catastrophe bonds
    - Higher coupon rates to investors for taking on risk

10.1 Bond Characteristics

- Innovation in the Bond Market
  - Indexed bonds
    - Payments tied to general price index/price of particular commodity
    - Treasury Inflation Protected Securities (TIPS): Par value of bond increases with consumer price index
    - $\text{Nominal return} = \frac{Interest + Price\ appreciation}{Initial\ price}$
    - $\text{Real return} = \frac{1 + Nominal\ return}{1 + Inflation} - 1$

Table 10.1 Principal and Interest Payments

Principal and interest payments for a Treasury Inflation Protected Security

Time	Inflation in Year Just Ended	Par Value	Coupon Payment	+	Principal Repayment	=	Total Payment
0		$1,000.00					
1	2%	1,020.00	$40.80		0		$ 40.80
2	3	1,050.60	42.02		0		42.02
3	1	1,061.11	42.44		$1,061.11		1,103.55

10.2 Bond Pricing

- Bond value = Present value of coupons + Present par value
- Bond value = $\sum_{t=1}^{T} \frac{Coupon}{(1+r)^t} + \frac{Par\ value}{(1+r)^T}$
  - T = Maturity date
  - r = discount rate
- Bond price = $Coupon \times \frac{1}{r}\left[1 - \frac{1}{(1+r)^T}\right] + Par\ value \times \frac{1}{(1+r)^T}$

  = $Coupon \times Annuity\ factor(r,T) + Par\ value \times PV\ factor\ (r,T)$

10.2 Bond Pricing

- Prices fall as market interest rate rises
- Interest rate fluctuations are primary source of bond market risk
- Bonds with longer maturities more sensitive to fluctuations in interest rate

Figure 10.3 Inverse Relationship between Bond Prices and Yields

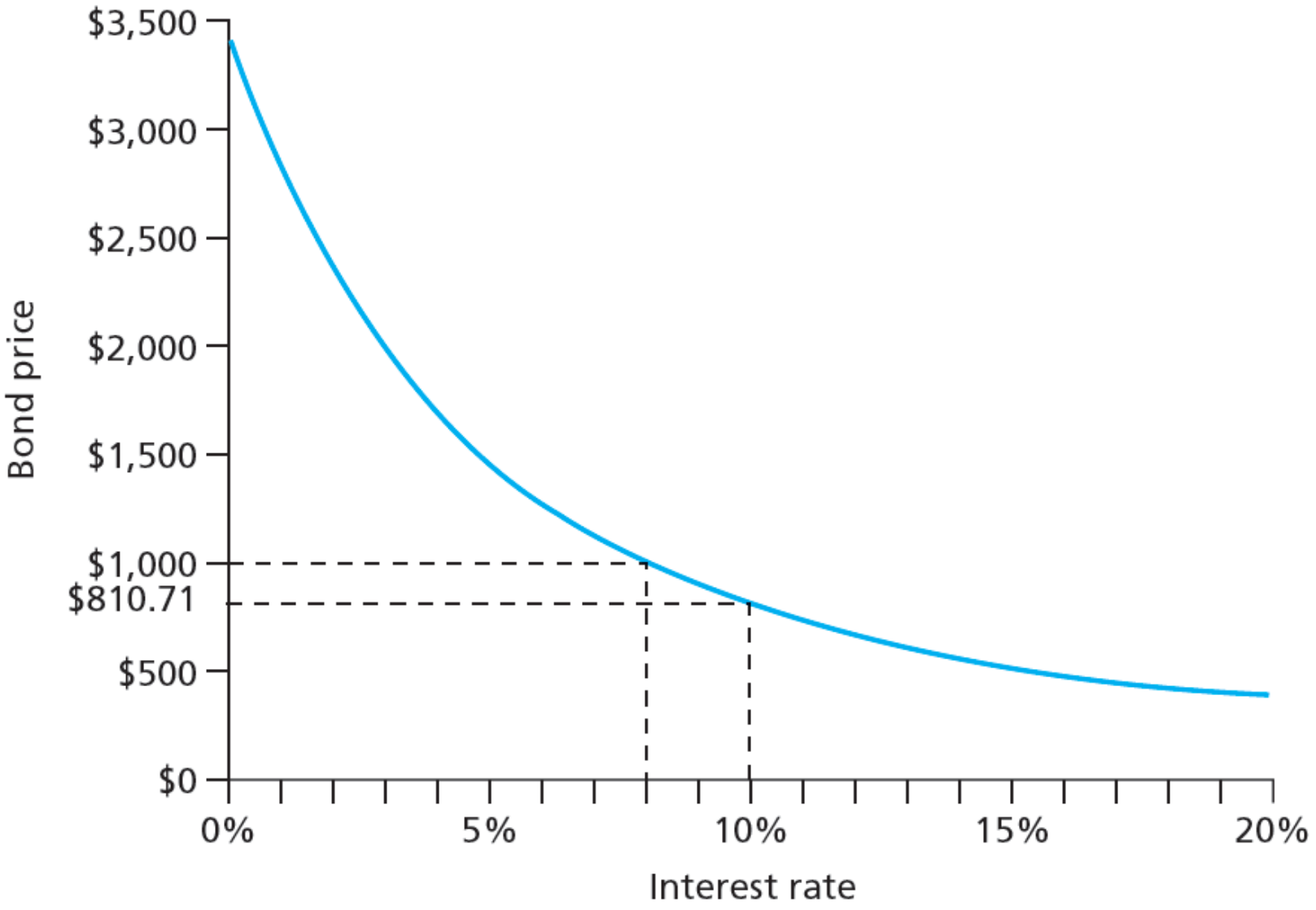


Table 10.2 Bond Prices at Different Interest Rates

Time to Maturity	Bond Price at Given Market Interest Rate				
	2%	4%	6%	8%	10%
1 year	$1,059.11	$1,038.83	$1,019.13	$1,000.00	$981.41
10 years	1,541.37	1,327.03	1,148.77	1,000.00	875.38
20 years	1,985.04	1,547.11	1,231.15	1,000.00	828.41
30 years	2,348.65	1,695.22	1,276.76	1,000.00	810.71

10.2 Bond Pricing

- Bond Pricing between Coupon Dates
  - Invoice price = Flat price + Accrued interest
- Bond Pricing in Excel
  - =PRICE (settlement date, maturity date, annual coupon rate, yield to maturity, redemption value as percent of par value, number of coupon payments per year)

Spreadsheet 10.1 Valuing Bonds

	6.25% coupon bond,		4.375% coupon bond,		8% coupon bond,
	maturing August 15, 2023	Formula in column B	maturing Nov 15, 2039		30-year maturity
Settlement date	8/15/2011	=DATE(2011,8,15)	8/15/2011		1/1/2000
Maturity date	8/15/2023	=DATE(2023,8,15)	11/15/2039		1/1/2030
Annual coupon rate	0.0625		0.04375		0.08
Yield to maturity	0.02598		0.03697		0.1
Redemption value (% of face value)	100		100		100
Coupon payments per year	2		2		2
Flat price (% of par)	137.444	=PRICE(B4,B5,B6,B7,B8,B9)	111.819		81.071
Days since last coupon	0	=COUPDAYBS(B4,B5,2,1)	92		0
Days in coupon period	184	=COUPDAYS(B4,B5,2,1)	184		182
Accrued interest	0	=(B13/B14)*B6*100/2	1.094		0
Invoice price	137.444	=B12+B15	112.913		81.071

10.3 Bond Yields

- Yield to Maturity
  - Discount rate that makes present value of bond's payments equal to price.
- Current Yield
  - Annual coupon divided by bond price
- Premium Bonds
  - Bonds selling above par value
- Discount Bonds
  - Bonds selling below par value

Spreadsheet 10.2 Finding Yield to Maturity

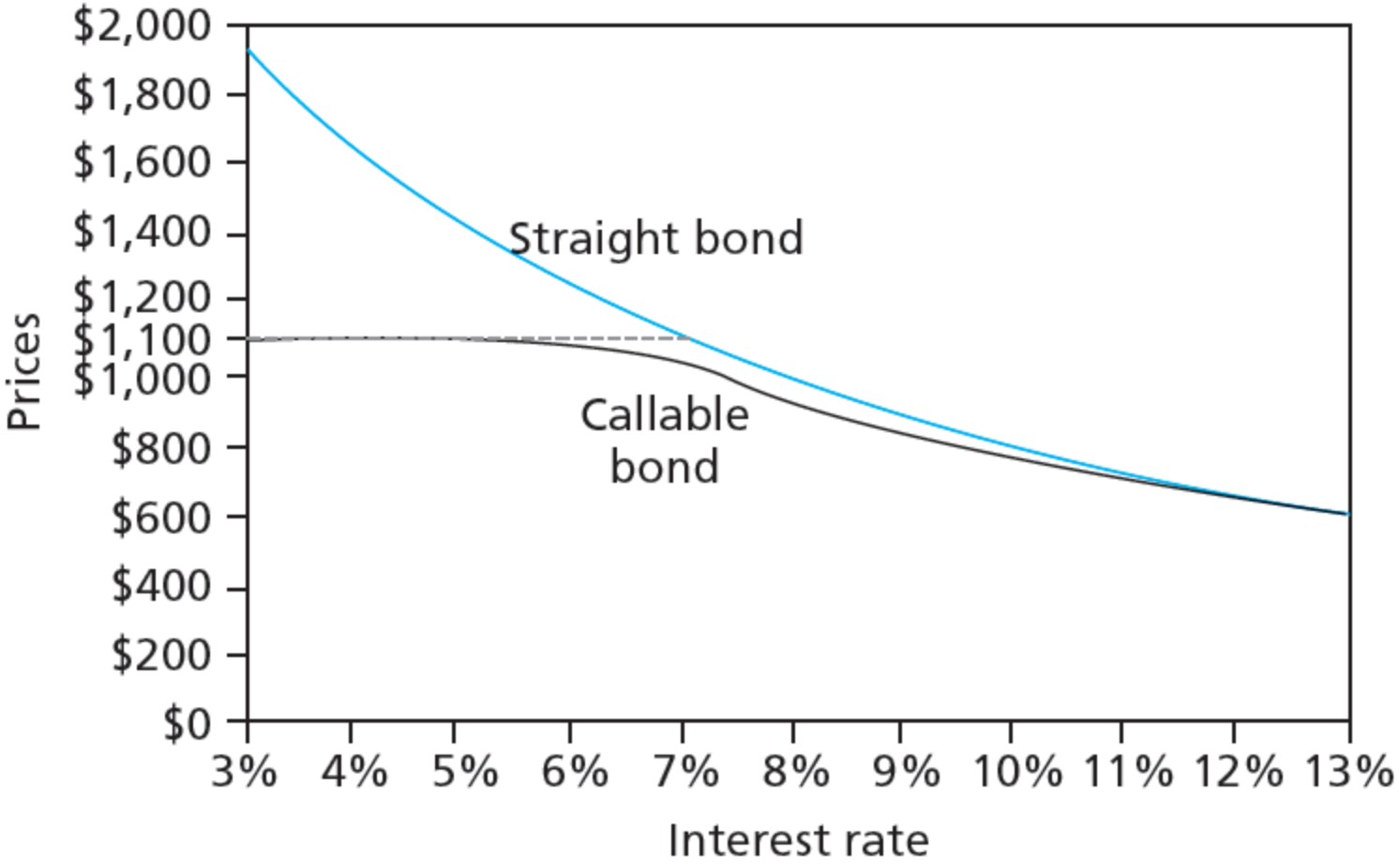
	Semiannual coupons		Annual coupons
Settlement date	1/1/2000		1/2/2000
Maturity date	1/1/2030		1/2/2030
Annual coupon rate	0.08		0.08
Bond price (flat)	127.676		127.676
Redemption value (% of face value)	100		100
Coupon payments per year	2		1
Yield to maturity (decimal)	0.0600		0.0599

The formula entered here is =YIELD(B3,B4,B5,B6,B7,B8)

10.3 Bond Yields

- Yield to Call
  - Calculated like yield to maturity
  - Time until call replaces time until maturity; call price replaces par value
  - Premium bonds more likely to be called than discount bonds

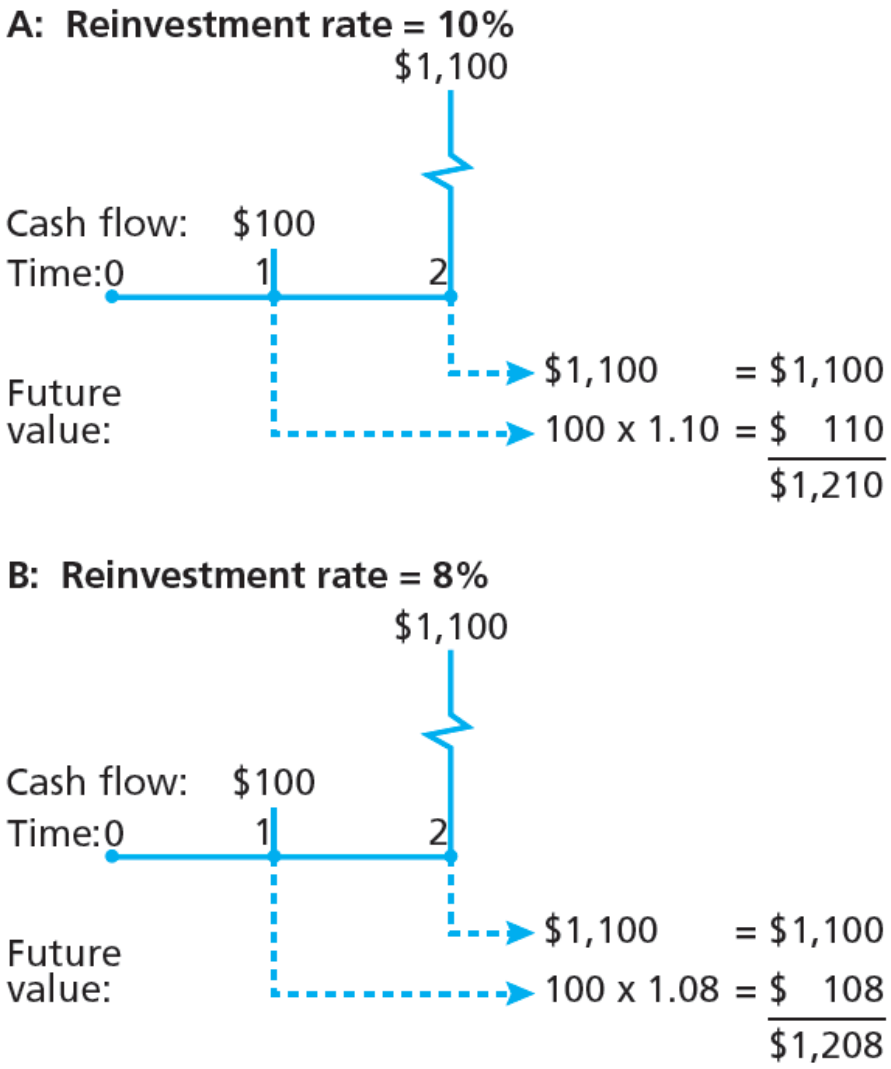
Figure 10.4 Bond Prices: Callable and Straight Debt



10.3 Bond Yields

- Realized Compound Returns versus Yield to Maturity
  - Realized compound return
    - Compound rate of return on bond with all coupons reinvested until maturity
  - Horizon analysis
    - Analysis of bond returns over multiyear horizon, based on forecasts of bond's yield to maturity and investment options
  - Reinvestment rate risk
    - Uncertainty surrounding cumulative future value of reinvested coupon payments

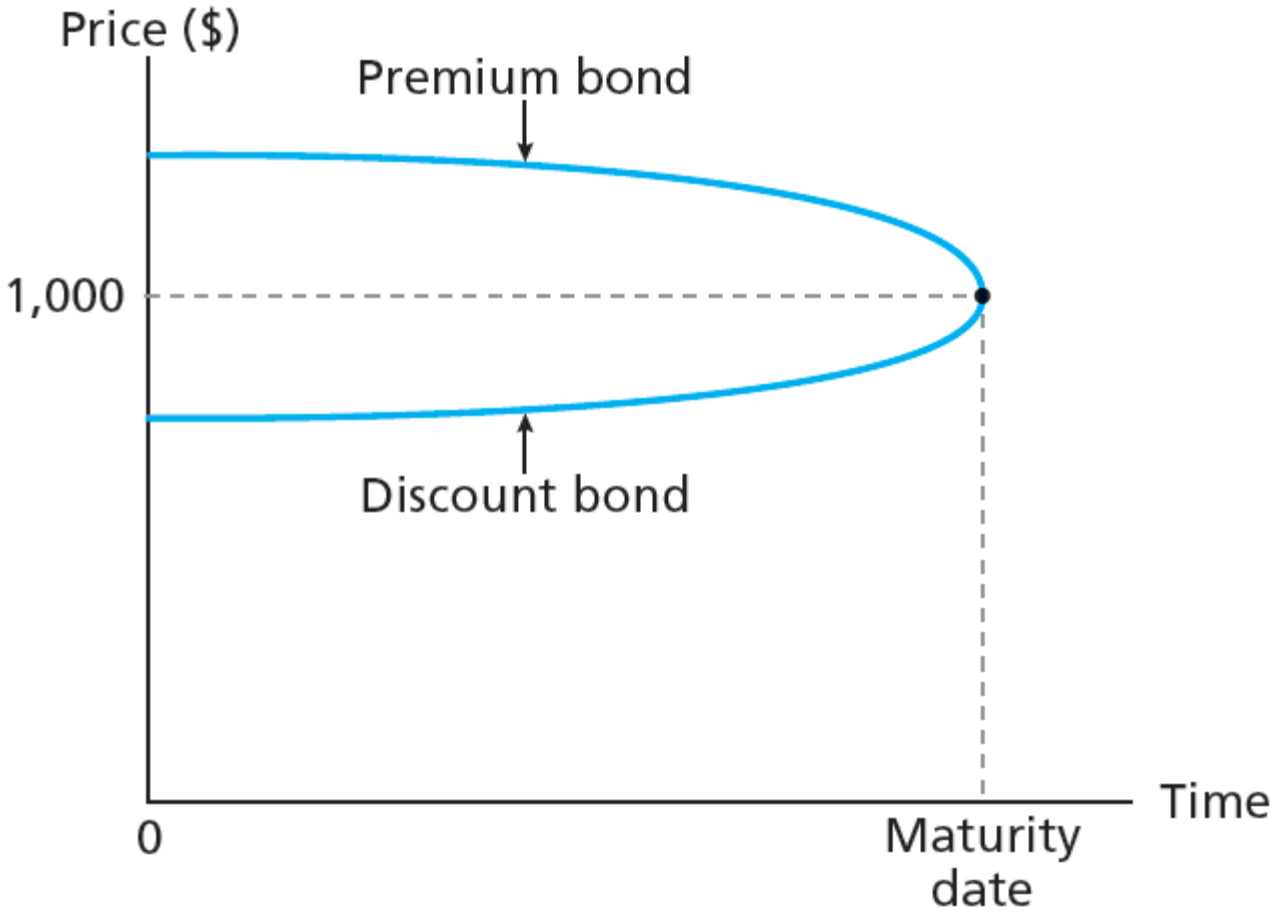
Figure 10.5 Growth of Invested Funds



10.4 Bond Prices Over Time

- Yield to Maturity versus Holding Period Return (HPR)
  - Yield to maturity measures average RoR if investment held until bond matures
  - HPR is RoR over particular investment period; depends on market price at end of period

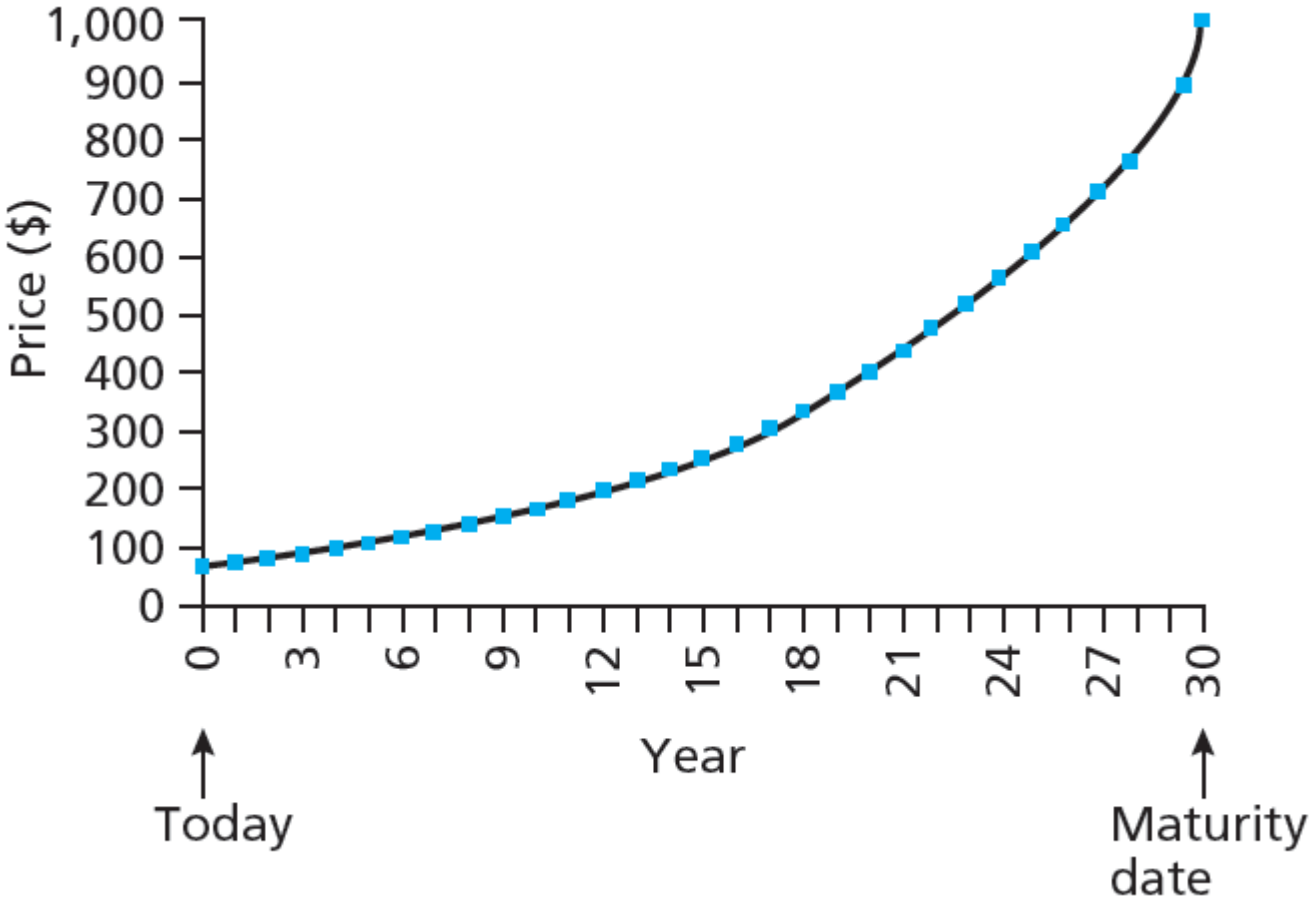
Figure 10.6 Price Paths of Coupon Bonds in Case of Constant Market Interest Rates



10.4 Bond Prices Over Time

- Zero-Coupon Bonds and Treasury STRIPS
  - Zero-coupon bond: Carries no coupons, provides all return in form of price appreciation
  - Separate Trading of Registered Interest and Principal of Securities (STRIPS): Oversees creation of zero-coupon bonds from coupon-bearing notes and bonds

Figure 10.7 Price of 30-Year Zero-Coupon Bond over Time at Yield to Maturity of 10%



10.4 Bond Prices Over Time

- After-Tax Returns
  - Built-in price appreciation on original-issue discount bonds constitutes implicit interest payment to holder
  - IRS calculates price appreciation schedule to determine taxable interest income for built-in appreciation

10.5 Default Risk and Bond Pricing

- Investment grade bond
  - Rated BBB and above by S&P or Baa and above by Moody's
- Speculative grade or junk bond
  - Rated BB or lower by S&P, Ba or lower by Moody's, or unrated

Figure 10.8 Bond Rating Classes

	Bond Ratings			
	Very High Quality	High Quality	Speculative	Very Poor
Standard & Poor's	AAA AA	A BBB	BB B	CCC D
Moody's	Aaa Aa	A Baa	Ba B	Caa C

At times both Moody's and Standard & Poor's use adjustments to these ratings. S&P uses plus and minus signs: A+ is the strongest A rating and A– the weakest. Moody's uses a 1, 2, or 3 designation, with 1 indicating the strongest.

10.5 Default Risk and Bond Pricing

- Determinants of Bond Safety
  - Coverage ratios: Company earnings to fixed costs
  - Leverage ratio: Debt to equity
  - Liquidity ratios
    - Current: Current assets to current liabilities
    - Quick: Assets excluding inventories to liabilities
  - Profitability ratios: Measures of RoR on assets or equity
  - Cash flow-to-debt ratio: Total cash flow to outstanding debt

Table 10.3 Financial Ratios and Default Risk

	Three-Year (2002 to 2004) Medians						
	AAA	**AA**	**A**	**BBB**	**BB**	**B**	**CCC**
EBIT interest coverage multiple	23.8	19.5	8.0	4.7	2.5	1.2	0.4
EBITDA interest coverage multiple	25.5	24.6	10.2	6.5	3.5	1.9	0.9
Funds from operations/total debt (%)	203.3	79.9	48.0	35.9	22.4	11.5	5.0
Free operating cash flow/total debt (%)	127.6	44.5	25.0	17.3	8.3	2.8	(002.1)
Total debt/EBITDA multiple	0.4	0.9	1.6	2.2	3.5	5.3	7.9
Return on capital (%)	27.6	27.0	17.5	13.4	11.3	8.7	3.2
Total debt/total debt + equity (%)	12.4	28.3	37.5	42.5	53.7	75.9	113.5

10.5 Default Risk and Bond Pricing

- Bond Indentures
  - Indenture
    - Defines contract between issuer and holder
  - Sinking fund
    - Indenture calling for issuer to periodically repurchase some proportion of outstanding bonds before maturity

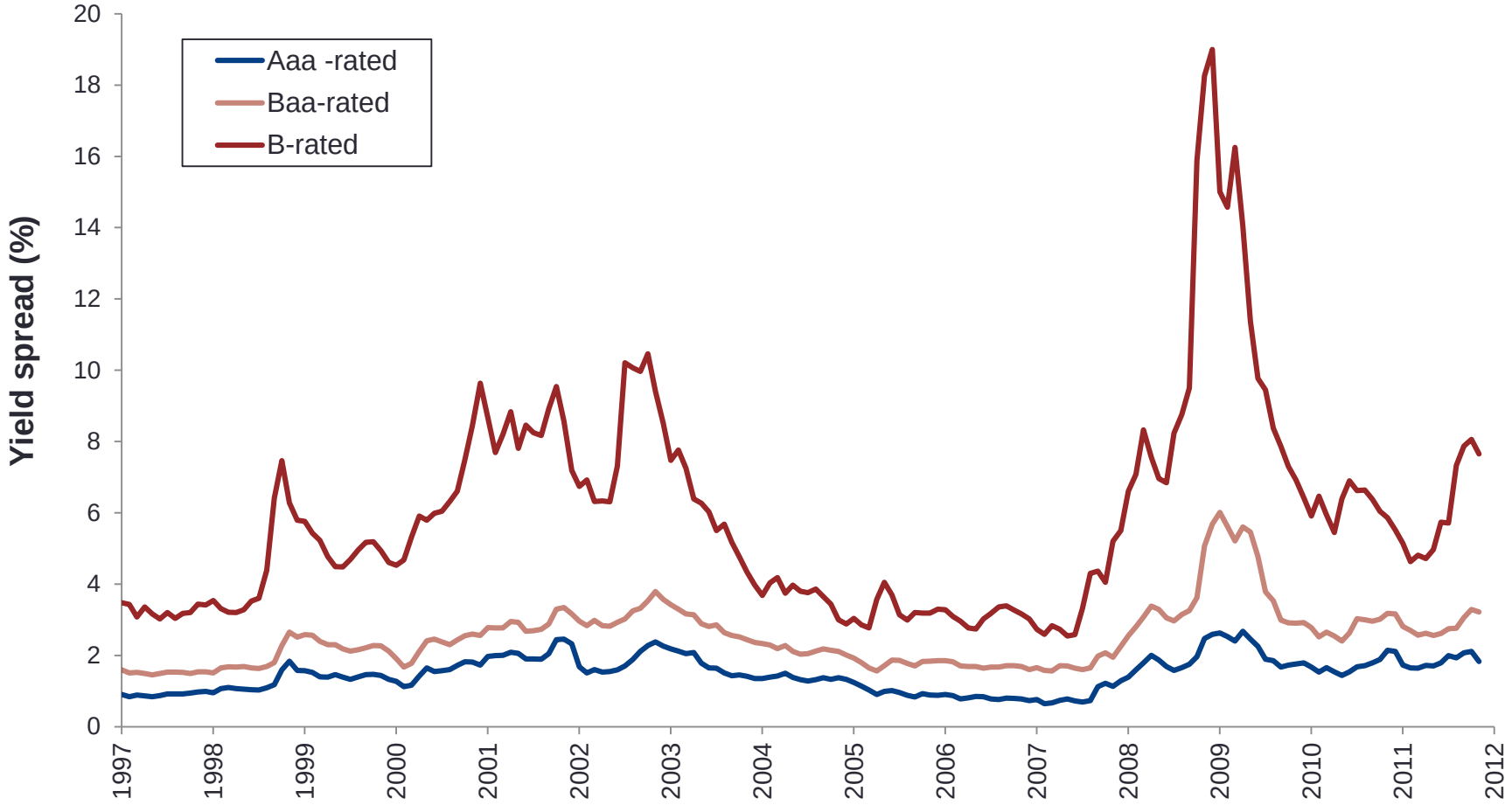
10.5 Default Risk and Bond Pricing

- Bond Indentures
  - Subordination clause
    - Restrictions on additional borrowing stipulating senior bondholders paid first in event of bankruptcy
  - Collateral
    - Specific asset pledged against possible default
  - Debenture
    - Bond not backed by specific collateral

10.5 Default Risk and Bond Pricing

- Yield to Maturity and Default Risk
  - Stated yield is maximum possible yield to maturity of bond
  - Default premium
    - Increment to promised yield that compensates investor for default risk

Figure 10.10 Yield Spreads between Corporate and 10-Year Treasury Bonds



10.5 Default Risk and Bond Pricing

- Credit Default Swaps (CDS)
  - Insurance policy on default risk of corporate bond or loan
  - Designed to allow lenders to buy protection against losses on large loans
    - Later used to speculate on financial health of companies

Figure 10.11A Prices of CDSs, U.S. Banks

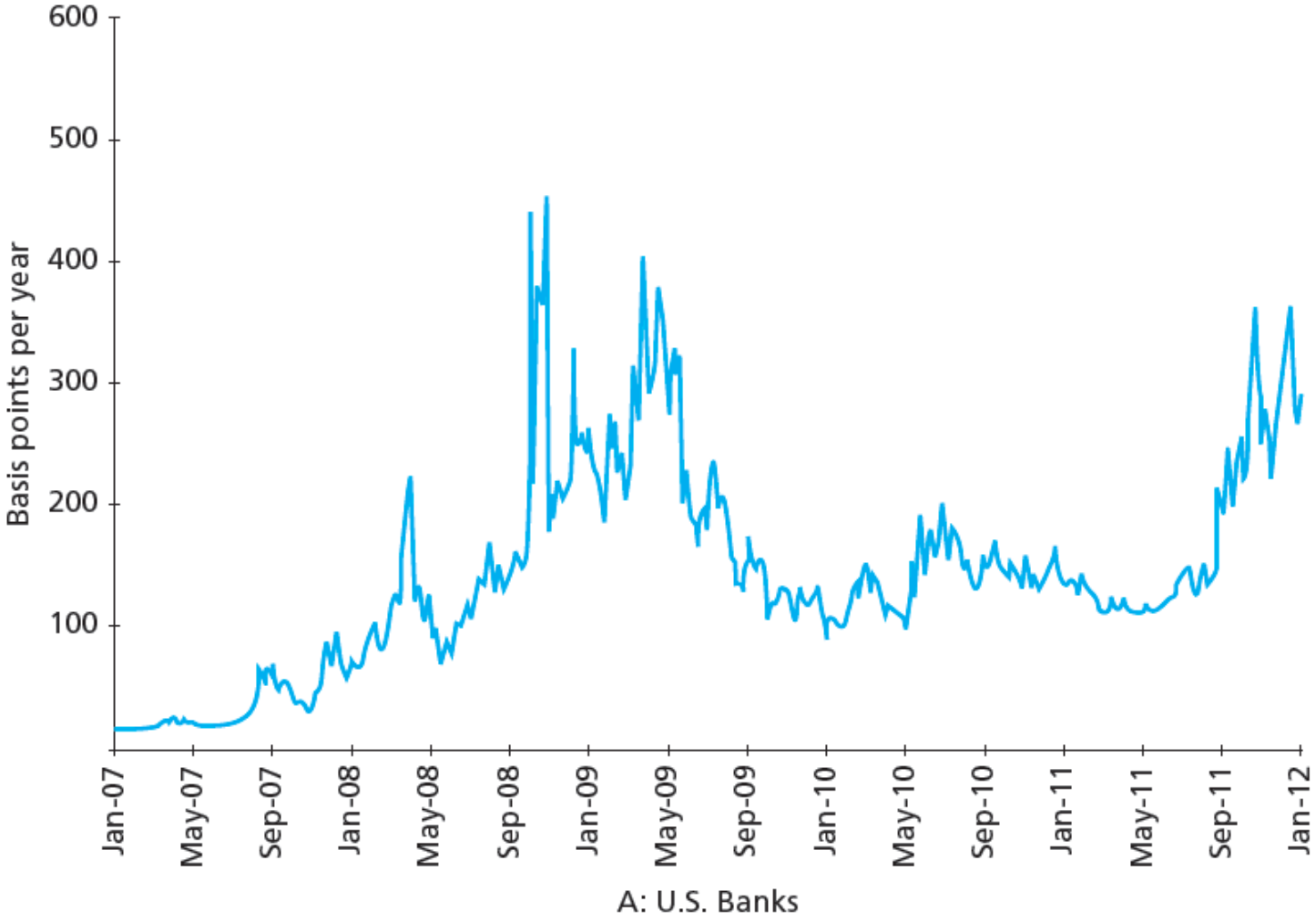
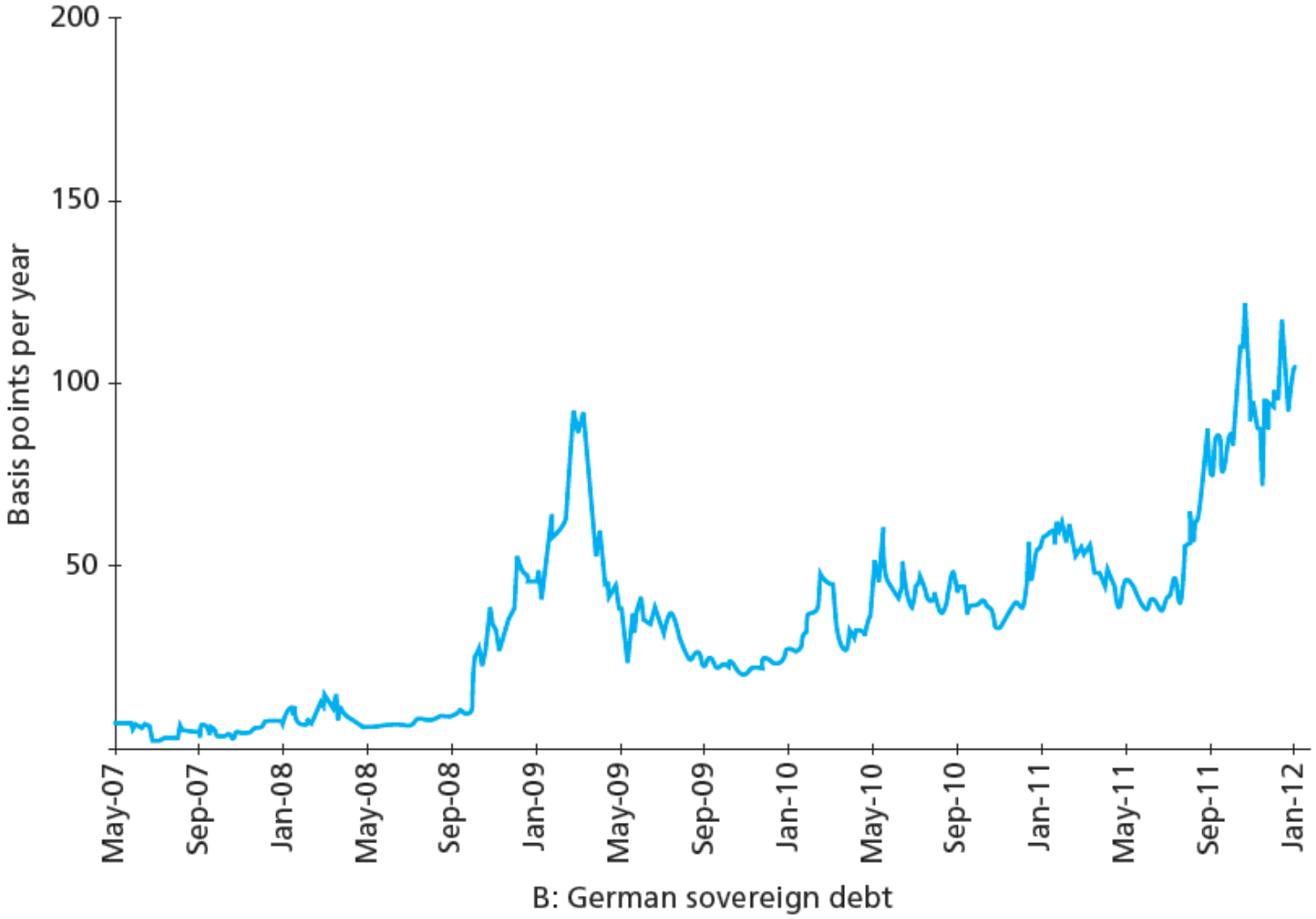


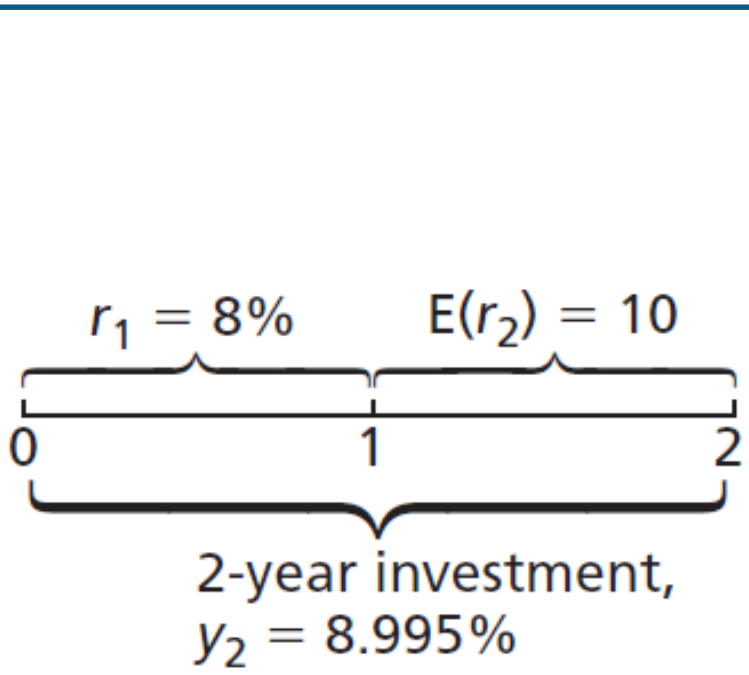
Figure 10.11B Prices of CDSs, German Sovereign Debt



10.6 The Yield Curve

- Yield Curve
  - Graph of yield to maturity as function of term to maturity
- Term Structure of Interest Rates
  - Relationship between yields to maturity and terms to maturity across bonds
- Expectations Hypothesis
  - Yields to maturity determined solely by expectations of future short-term interest rates

Figure 10.13 Returns to Two 2-Year Investment Strategies



2-year cumulative expected returns

$1.08 \times 1.10 = 1.188$

$1.08995^2 = 1.188$

10.6 The Yield Curve

- Forward Rate
  - Inferred short-term ROI for future period, makes expected total return of long-term bond equal to that of rolling over short-term bonds
  - $(1 + y_n)^n = (1 + y_{n-1})^{n-1}(1 + f_n)$

10.6 The Yield Curve

- Liquidity Preference Theory
  - Investors demand risk premium on long-term bonds
  - Liquidity premium
    - Extra expected return demanded by investors as compensation for greater risk of long-term bonds
  - Spread between forward ROI and expected short sale
    - $f_n = E(r_n) + Liquidity\ premium$

Figure 10.14 Illustrative Yield Curves

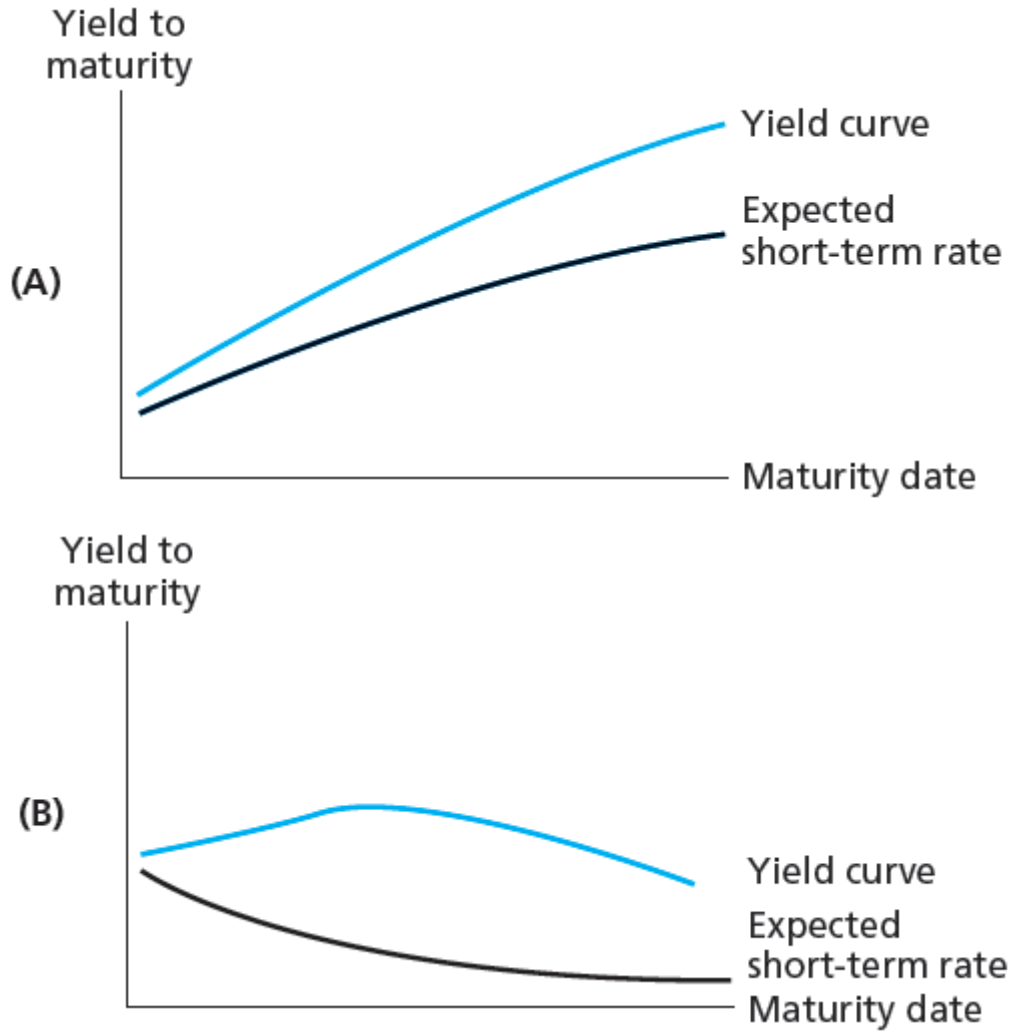


Figure 10.15 Term Spread: Yields on 10-Year versus 90-day Treasury Securities